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Brain Tumour Detection and Classification Using Deep Learning

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Abstract
Now a day's tumor is second leading cause of cancer. Currently Doctors locate the positions and area of a brain tumor by looking at the MRI of the brain manually. This project helps to reduce the inaccuracy and time consumption in detection, and it also provides information about brain. This study presents Convolution neural network architecture for brain tumour detection and classification using magnetic resonance imaging (MRI) as datsets. The performance of the model is to predict whether the given image is tumours or non tumours and classify the tumour image and using use classification to classify brain tumors into three categories: glioma, meningioma, and pituitary tumors and implemented in an Android application.
Keywords: *Brain Modelling, Classification, Convolutional Neural Networks, Deep Learning, Magnetic Resonance Imaging.*

1. Introduction
This paper aims to develop a android application using android studio and CNN architecture which helps in detection and classification of brain tumour. As CNN is proven to be superior in detecting various diseases from Xray's, CT scans and MRI scans, and the datasets of this paper are MRI images which are widely used technology in medical that deals with tissues and cell abnormalities, objectives is to provide and brain tumour application that will detect the tumour and classify based on three categories, also provide information about brain, type of brain tumours, causes and its diagnosis.

1.1. Literature Survey
In [1] author Lin and Chang detected brain tumour by concept of k-means to predict object and clubbed similar groups together with same colour using colour-based segmentation. Main feature of this paper was clustering that is done from greyscale with k means algorithm. In [2] author Sharma and Komal worked with dataset of MRI scans and applied segmentation and filters to identify brain tumour and its classification and its feature detection. In [3] author Guotai Wang used CNN 4 to perform segmentation on brain MRI scans. Guotai wang proposed project can also highlight brain organs and interactive with the users. In [4] author Sajid detected brain tumour in this project using hybrid Convolutional neural network model, the author used unique two-phase training method and dropout from fully connection, that enchanced the performance of the working model, the accuracy of the result can higher if more training data are given. Their model had 86% dice score and 91% specification and 86% sensitivity performed on BRATS MR images dataset. In [5] author Nayak detected brain tumour using CNN based a dense EfficientNet to predict four different types brain tumour from 3260 MR images data set, accuracy is 98.78% and F1 score is 98.0%.the experts analyzed ResNet-50, MobileNetV2and MobileNet, with their dense efficient network which showed better performance.

1.2. Existing System
Doctors detect brain tumour manually where they locate brain tumour looking at the patients MRI images which can be time consuming and complex at times [6-9].

1.2.1. Drawbacks of Existing System
Manual Interpretation: Human radiologists

manually analyse the images, which can be time-consuming and subjective [10].

False Positives and Negatives: Interpretation errors can occur, leading to false positives (indicating a tumour when there isn't one) or false negatives (missing an actual tumour).

Dependency on Expertise: Accurate diagnosis heavily relies on the proficiency of the radiologist, which can vary [11].

Resource Intensive: The process involves significant human effort and resources, which may lead to delays in diagnosis and treatment [12-14].

Inability to Predict Tumour Type: It may be challenging to determine the type of tumour solely based on imaging [15].

1.3. Proposed System

Image Pre-Processing: Image pre-processing is a critical step in the detection and classification of brain tumours, ensuring that the images fed into the Convolutional Neural Network (CNN) are of high quality and suitable for analysis. Pre Processing steps includes image resizing and normalization [16-19].

Deep learning architecture: In our paper, we have used the Convolutional Neural Network (CNN)architecture for Brain tumour Detection and Classification. The CNN architecture consists of Convolution layer, pooling layer, fully connected layer [20].

Classification Algorithm: Once a tumour is detected, a classification algorithm is employed to determine the specific type of tumour. The classification is performed using another neural network that has been trained on labelled data to recognize and distinguish between gliomas, meningiomas, and pituitary tumours.

Integration with Android Application: The detection and classification models are integrated into an Android application developed using Android Studio [21].

1.4. Problem Statement

The current process of brain tumour detection heavily relies on manual interpretation of MRI scans by radiologists. This approach is time-consuming, subjective, and can lead to errors, including false positives and false negatives. Additionally, it is resource-intensive and may result in delays in diagnosis and treatment. The inability to provide detailed quantitative data about the tumour further hinders accurate assessments [22].

1.5. Objectives

- To provide doctors good software to identify tumours and their causes and saves patient's time.
- Detect a tumour appropriately at early stages.
- To reduce manual identification which is time consuming and inaccurate sometimes.
- To provide information about Brain, type obrain tumours, causes and its diagnosis.
- To develop Brain tumour detection application and classify the tumours as well.

2. Methodology

The process of brain tumour detection using Convolutional Neural Networks (CNNs) involves several key steps, including data acquisition, preprocessing, model development, training, and evaluation. Here is an outline of the proposed methodology [23].

Data collection: Obtain brain imaging datasets such as MRI scans from reputable sources such as Kaggle.

Data pre-processing: Clean and preprocess the acquired data to ensure uniformity and quality.

Model development using Visual studio: Utilize Visual Studio, a comprehensive integrated development environment (IDE), to build and train the CNN model.

Model evaluation and testing: The evaluation process involved utilizing the testing dataset to assess the model's performance metrics, including accuracy, precision, recall, and F1-score, achieved through the predict function [24].

2.1. System Design

2.1.1. Block Diagram

Creating a block diagram involves depicting the key components and flow of information within the brain tumour detection system. Input from the datasets MRI scans are given as the input to the Convolutional Neural Network (CNN). In this paper there are three convolutional layer, 3 Pooling layer and 2 Fully connected layer. The convolutional layers and pooling layers are alternative to each other When the input image is given to the first convolutional layer the Convolutional procedure takes place , the feature maps of first convolutional layer is passed onto the

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first pooling layer where the dimension of the image is reduced , the feature maps of first pooling layer is passed upon the second convolutional layer and the procedure is continued till we achieve the feature maps of third pooling layer (Figure 1) , which is passed onto the fully connected layer where it accepts 1D input , it consist of feed forward network where the Detection classification of the images is done [25].

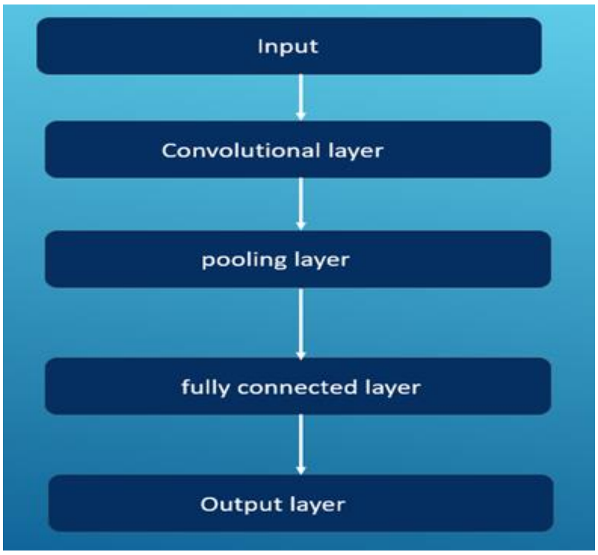

Figure 1 Block Diagram of Training Model

2.1.2. Model Description

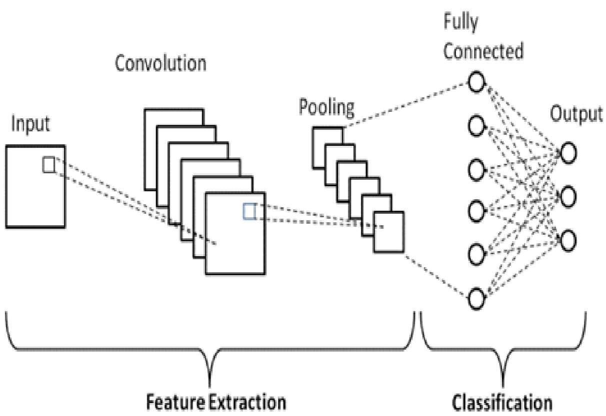

Figure 2 CNN Architecture

The architecture of CNN consists of three-layer Convolutional layer, pooling layer and Fully connected layer. The convolutional layer consist of two matrix they are input matrix and filter matrix , the filter matrix slide over the input matrix and extracts certain feature which is important for detection and classification of the brain tumour , the feature maps of Convolutional layer is passed onto the Pooling layer (Figure 2).Which reduces the size/dimension of the image, it is generally in three ways they are max pooling, average pooling and sum pooling , the feature maps of pooling layer is passed onto the fully connected layer which consists of the feed forward network and helps in classification/detection of the tumour.

3. Result and Discussion

3.1. Results

Step 1: Open The Icon with App Name Brain Tumour Detection

Step 2: Click On the Button "Click Here to Detect" from The Initial Front Page, That Will Redirect Us to Brain Tumour Prediction Page

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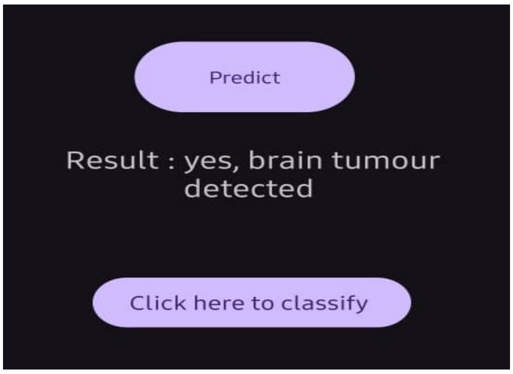
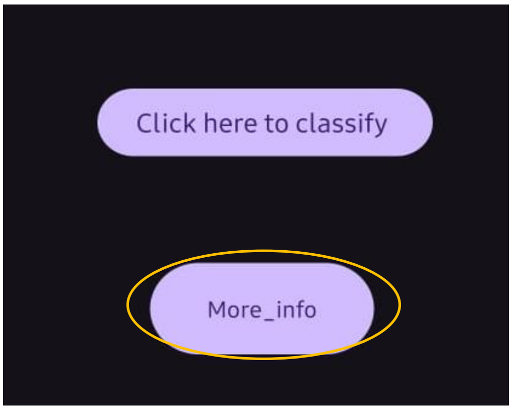
Step 3: Click On Select Button and Choose The MRI of Brain Scan and Upload It, Then Click On Predict Button

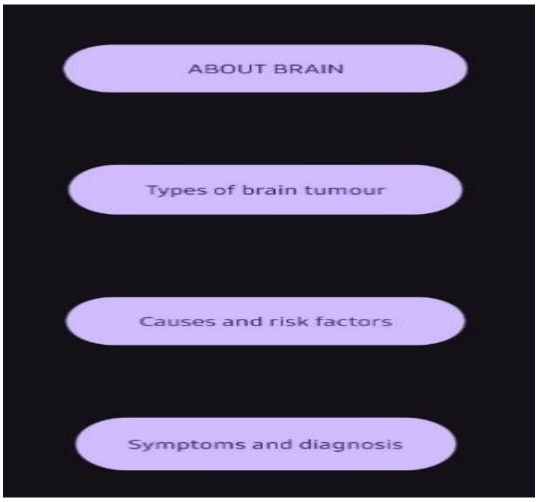
Step 4: Result of The MRI Scan Will Be Displayed, Whether It's a Tumourous or Non-Tumourous Brain Scan



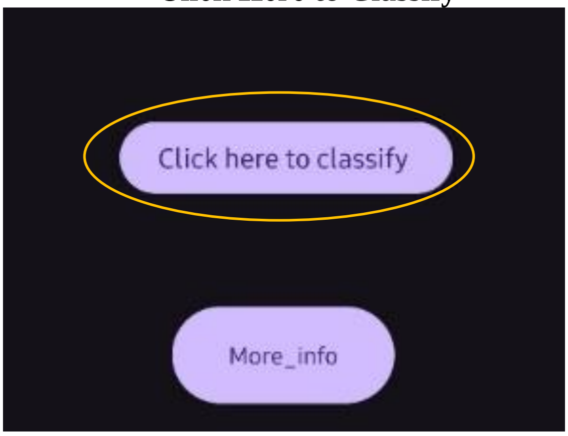
Step 6: For More Information About Click On the Button "More Info"



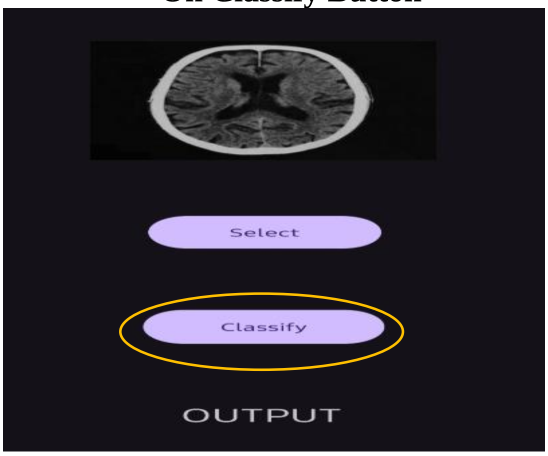
Step 7: In The Third Page Four New Categories of Buttons Are Present as Follows, That Provide Additional Information About Brain



Step 8: To Classify the Brain Tumour Click "Click Here to Classify"



Step 9: Click On Select Button and Choose The MRI of Brain Scan and Upload it & Then Click On Classify Button



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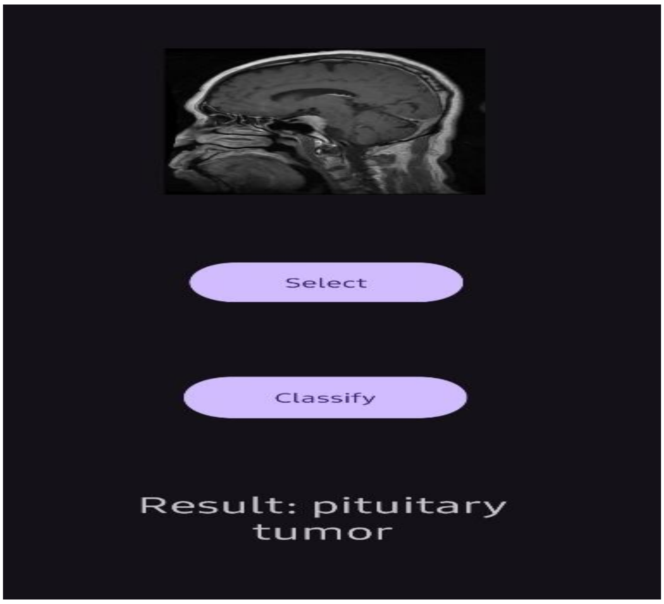
Step 11: Result of The MRI Scan Will Be Displayed, Specifying The Type of Brain Tumour



3.2. Discussion

The developed application addresses critical challenges in brain tumor diagnosis and classification. By automating these processes, the app not only saves time but also reduces the potential for human error. The inclusion of educational resources within the app empowers patients with knowledge about their condition, fostering better communication between patients and healthcare providers. The application's use of CNNs ensures robust performance in image analysis, making it a reliable tool in clinical settings. Future enhancements could include integrating the app with hospital information systems for seamless data sharing and incorporating additional features such as treatment suggestions based on tumor classification. (Refer Steps 1 to 11).

Conclusion

This brain tumor detection and classification application effectively addresses the critical problems of time-consuming and potentially inaccurate manual tumor identification. By leveraging advanced Deep learning techniques, particularly convolutional neural networks (CNNs), the application provides highly accurate and efficient detection and classification of brain tumors. The results confirm that the application can reliably identify the presence of tumors and classify them into Gliomas, Meningiomas, and Pituitary tumors. The comprehensive analysis in the results and discussion section validates the application's accuracy in detecting tumors and classifying them into the specified categories. The user-friendly interface and integrated educational resources further enhance the application's utility, making it a valuable tool for both healthcare providers and patients.

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References

[1]. M. Wu, C. Lin and C. Chang, "Brain Tumour Detection Using ColorBased K- Means Clustering Segmentation," 2015.
[2]. Sharma, Komal, Akwinder Kaur, and Shruti Gujral. "Brain tumour detection based on machine learning algorithms." (2014).
[3]. Wang, Guotai, et al. "Interactive medical image segmentation using deep learning with image-specific fine tuning." IEEE transactions on medical imaging 37.7 (2018): 1562-1573.,2021
[4]. Sajid s, Hussain, S.; Sarwar, A. Brain tumour detection and segmentation in MR images using deep learning. Arab. J. Sci. Eng. 2019, 44, 9249–9261.
[5]. Nayak, D.R.; Padhy, N.; Mallick, P.K.; Zymbler, M.; Kumar, S. Brain Tumour Classification Using Dense Efficient-Net. Axioms 2022, 11, 34.
[6]. Nayak, D.R.; Padhy, N.; Mallick, P.K.; Zymbler, M.; Kumar, S. Brain Tumor Classification Using Dense Efficient-Net. Axioms 2022, 11, 34.
[7]. Musallam, A.S.; Sherif, A.S.; Hussein, M.K. A New Convolutional Neural Network Architecture for Automatic Detection of Brain Tumors in Magnetic Resonance Imaging Images. IEEE Access 2022, 10, 2775–2782.

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https://doi.org/10.47392/IRJAEH.2024.0242

[8]. Khalil, H.A.; Darwish, S.; Ibrahim, Y.M.; Hassan, O.F. 3D-MRI brain tumor detection model using modified version of level set segmentation based on dragonfly algorithm. Symmetry 2020, 12, 1256.
[9]. Stadlbauer, A.; Marhold, F.; Oberndorfer, S.; Heinz, G.; Buchfelder, M.; Kinfe, T.M.; Meyer-Bäse, A. Radiophysiomics: Brain Tumors Classification by Machine Learning and Physiological MRI Data. Cancers 2022, 14, 2363.
[10]. Szegedy, C., Vanhoucke, V., Ioffe, S., Shlens, J., Wojna, Z.: Rethinking the Inception Architecture for Computer Vision, arXiv:1512.00567 [cs], Decembe
[11]. Sobhaninia, Zahra, et al. "Brain tumor segmentation using deep learning by type specific sorting of images." arXiv preprint arXiv:1809.07786 (2018)
[12]. Sharma, Komal, Akwinder Kaur, and Shruti Gujral. "Brain tumor detection based on machine learning algorithms." International Journal of Computer [11] Applications 103.1 (2014).
[13]. Long, C., Basharat, A., Hoogs, A.: A Coarse-to-fine Deep Convolutional Neural Network Framework for Frame Duplication Detection and Localization
[14]. Lundervold, Alexander Selvikvåg, and Arvid Lundervold. "An overview of deep learning in medical imaging focusing on MRI." Zeitschrift für Medizinische Physik 29.2 (2019): 102-127.
[15]. George, Dena Nadir, Hashem B. Jehlol, and Anwer Subhi Abdulhussein. "Brain Tumour Detection Using Shape features and Machine Learning Algorithms".
[16]. Kaliyannan, Gobinath Velu, et al. "Investigation on sol-gel based coatings application in energy sector–A review." Materials Today: Proceedings 45 (2021): 1138-1143.
[17]. Velu Kaliyannan, Gobinath, et al. "Utilization of 2D gahnite nanosheets as highly conductive, transparent and light trapping front contact for silicon solar cells." Applied Nanoscience 9 (2019): 1427-1437.
[18]. Sathishkumar, T. P., et al. "Investigation of chemically treated longitudinally oriented snake grass fiber-reinforced isophthallic polyester composites." Journal of Reinforced Plastics and Composites 32.22 (2013): 1698-1714.
[19]. Moganapriya, C., et al. "Dry machining performance studies on TiAlSiN coated inserts in turning of AISI 420 martensitic stainless steel and multi-criteria decision making using Taguchi-DEAR approach." Silicon (2021): 1-14.
[20]. Kaliyannan, Gobinath Velu, et al. "Development of sol-gel derived gahnite anti-reflection coating for augmenting the power conversion efficiency of polycrystalline silicon solar cells." Materials Science-Poland 37.3 (2019): 465-472.
[21]. Velu Kaliyannan, Gobinath, et al. "An extended approach on power conversion efficiency enhancement through deposition of ZnS-Al 2 S 3 blends on silicon solar cells." Journal of Electronic Materials 49 (2020): 5937-5946.
[22]. Sathishkumar, T. P., et al. "Investigation of chemically treated randomly oriented sansevieria ehrenbergii fiber reinforced isophthallic polyester composites." Journal of Composite Materials 48.24 (2014): 2961-2975.
[23]. Nayak, Ganesh Chandra, R. Rajasekar, and Chapal Kumar Das. "Dispersion of SiC coated MWCNTs in PEI/silicone rubber blend and its effect on the thermal and mechanical properties." Journal of Applied Polymer Science 119.6 (2011): 3574-3581.
[24]. Nayak, Ganesh Chandra, et al. "Effect of MWNTs and SiC-coated MWNTs on properties of PEEK/LCP blend." Journal of Nanotechnology 2009 (2009).
[25]. Manikandan, Ayyar, et al. "Morphological, thermal, and blood-compatible properties of electrospun nanocomposites for tissue engineering application." Polymer Composites 39 (2018): E132-E139.